

# **NOISE ASSESSMENT**

**Sol Orchard- Valley Center Solar Project  
MUP 3300-11-027  
Environmental Log Number 3910 11-08-010  
APN 188-290-20-00**

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## **GLOSSARY OF TERMS**

**Sound Pressure Level (SPL):** a ratio of one sound pressure to a reference pressure ( $L_{ref}$ ) of 20  $\mu$ Pa. Because of the dynamic range of the human ear, the ratio is calculated logarithmically by  $20 \log (L/L_{ref})$ .

**A-weighted Sound Pressure Level (dBA):** Some frequencies of noise are more noticeable than others. To compensate for this fact, different sound frequencies are weighted more.

**Minimum Sound Level ( $L_{min}$ ):** Minimum SPL or the lowest SPL measured over the time interval using the A-weighted network and slow time weighting.

**Maximum Sound Level ( $L_{max}$ ):** Maximum SPL or the highest SPL measured over the time interval the A-weighted network and slow time weighting.

**Equivalent sound level ( $L_{eq}$ ):** the true equivalent sound level measured over the run time.  $L_{eq}$  is the A-weighted steady sound level that contains the same total acoustical energy as the actual fluctuating sound level.

**Day Night Sound Level ( $L_{dn}$ ):** Representing the Day/Night sound level, this measurement is a 24 –hour average sound level where 10 dB is added to all the readings that occur between 10 pm and 7 am. This is primarily used in community noise regulations where there is a 10 dB “Penalty” for night time noise. Typically  $L_{dn}$ ’s are measured using A weighting.

**Community Noise Exposure Level (CNEL):** The accumulated exposure to sound measured in a 24-hour sampling interval and artificially boosted during certain hours. For CNEL, samples taken between 7 pm and 10 pm are boosted by 5 dB; samples taken between 10 pm and 7 am are boosted by 10 dB.

**Octave Band:** An octave band is defined as a frequency band whose upper band-edge frequency is twice the lower band frequency.

**Third-Octave Band:** A third-octave band is defined as a frequency band whose upper band-edge frequency is 1.26 times the lower band frequency.

**Response Time (F,S,I):** The response time is a standardized exponential time weighting of the input signal according to fast (F), slow (S) or impulse (I) time response relationships. Time response can be described with a time constant. The time constants for fast, slow and impulse responses are 1.0 seconds, 0.125 seconds and 0.35 milliseconds, respectively.

## **EXECUTIVE SUMMARY**

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This noise study has been completed to determine the noise impacts associated with the development of the proposed Sol Orchard- Valley Center Solar Project. The Project would consist of clearing and site preparation 46 of 55 acres and then installing self tracking solar panels. The Project is located in the unincorporated community of Valley Center in northern portion of San Diego County, CA.

Based on the empirical data, the manufactures specifications and the distances to the property lines the unshielded cumulative noise levels from the proposed transformers/inverters were found to be below the most restrictive nighttime property line standard of 45 dBA at the A-70 zoning. No impacts are anticipated and no mitigation is required.

The measured Corona Affect noise levels were found to be below the County of San Diego's most restrictive nighttime standard of 45 dBA. This was also consistent with previously measured and modeled noise levels on transmission line projects throughout California. No impacts from the Corona Affect are anticipated from the connection to existing distribution lines associated with the Project.

At a distance as close as 165 feet, the point source noise attenuation from the grading activities and the nearest property line is -10.4 dBA. This would result in an anticipated worst case eight-hour average combined noise level of 74.9 dBA at the property line. During the installation of the PV panels, a noise level of 74.9 dBA would result at a distance of 275 feet. The installation equipment is anticipated to average a distance of more than 300 feet from the nearest property line. Given this and the spatial separation of the equipment over the large site area, the noise levels of the grading and PV panel installation are anticipated to comply with the County of San Diego's 75 dBA standard at all Project property lines.

Additionally, the County Noise Ordinance Section 36.410, states that no person shall produce or cause to be produced an impulsive noise that exceeds the maximum sound level shown of 82 dBA (at residential uses), when measured at the boundary line of the property where the noise source is located or on any occupied property where the noise is received, for 25 percent of the minutes in the measurement period. To reduce the maximum noise level of 95 dBA to 82 dBA the pile driver would need to be located 215 feet from the nearest occupied residential property line or only operate 25% of the hourly or daily duration (15 minutes of any hour and 2 hours of a 8 hour work day) when located within that distance. Based on these duration and distance parameters the impulsive noise levels are anticipated to be below the County's most restrictive 82 dBA threshold and no impacts are anticipated and no mitigation measures are required.

## 1.0 INTRODUCTION

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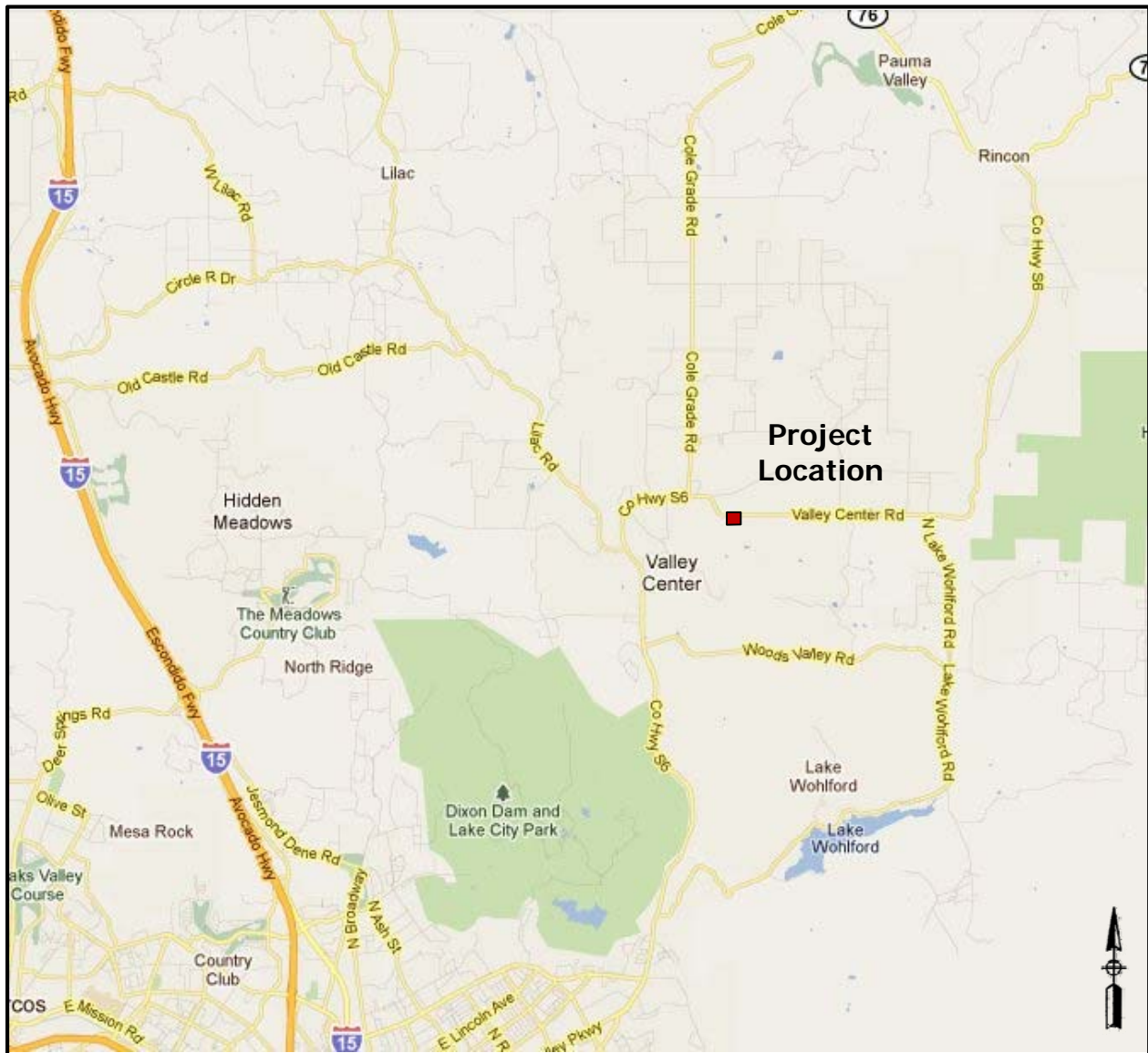
This noise study was completed to determine the noise impacts associated with the development of the proposed Sol Orchard- Valley Center Solar Project. The Project is located at 33° 14.020' N and 117° 0.417' W, between Valley Center Road and Vesper Road within the County of San Diego. The general location of the Project is shown in Figure 1-A on the following page.

### 1.1 Project Description

The Project proponent is preparing an application for development and operation of a photovoltaic (PV) solar farm to be located on privately-held lands near Valley Center. The Project would require approval from the County of San Diego for a Major Use Permit (MUP) to allow for the construction, operation, and maintenance of such facilities for the long-term generation of solar energy. The proposed facilities would have an overall production capacity of 7.5 Megawatts (MW) (alternating current – AC). The Project is expected to supply roughly 30-90 percent of power delivered to the Valley Center area, depending on the time of day. No export to transmission is anticipated. The proposed PV solar facilities would be installed on a portion of an approximately 55-acre parcel, under the ownership of the Project applicant, to achieve the intended MW output; however, development and MUP authority would be limited to approximately 46 acres of the parcel, allowing the unaffected acreage to generally remain in its present state (single-family residential use with supporting outbuildings, with exception of removal of an existing mobile home). The Project design would consist of a series of single-axis tracking photovoltaic solar panels supported on a galvanized driven H-pile post system. In isolated cases where geotechnical constraints are encountered, a ballast foundation system would be provided. The panels would be made of monocrystalline or polycrystalline material.

The solar panels would be aligned in rows and would face to the east in the morning and to the west in the evening hours, tracking the sun along the vertical axis to maximize solar absorption during the hours of daylight. The panels would be rack-mounted in a three-panel system, measuring approximately eight feet from the ground surface to the top of panel on flat surfaces and a maximum of 11.5 feet on sloped surfaces. As the height of the proposed PV solar panels would range from approximately 8-11.5 feet as measured from ground surface, the solar panels would not represent elements of large scale or height within the existing landscape. The length of each row of panels would be approximately 300 feet along the north/south axis. The ultimate arrangement/number of PV solar panels, racking, inverter pads and structures, and internal access are shown in on the MUP Plot Plan to illustrate the general configuration of the proposed solar collection system; however, this layout is subject to modification at final engineering design. Energy generated by the Project would be delivered to an existing 12 kV distribution line that runs parallel to Valley Center Road. The site plans for the proposed project configuration used for this analysis is shown in Figure 1-B on Page 3 of this report.

**Figure 1-A: Project Vicinity Map**



Source: Google Maps, 7/11



# Vesper Road





## 1.2 Environmental Settings & Existing Conditions

### a) Settings & Locations

The Project would consist of a PV solar generation project on a single parcel of land to allow for the transport of the power generated to an existing SDG&E transmission lines. The County Assessor Parcel Number (APN) affected by the proposed Project for the main facilities include 188-290-20 (approximately 55 acres). The main project access will be located at the southern edge of the site on Valley Center Road with a secondary access on Vesper Road. The zoning for the Project parcel and all surrounding land uses is rural residential/agricultural (A-70).

### b) Existing Noise Conditions

The Project is located adjacent to Valley Center Road and Vesper Road and previously used for agriculture. Valley Center Road is described as a Community Collector (2.1D) roadway and Vesper Road is a local roadway in the County of San Diego's Circulation Element. Existing noise occurs mainly from vehicular traffic traveling on the adjacent roadways and agricultural equipment.

## 1.3 Methodology and Equipment

### a) Noise Measuring Methodology and Procedures

To determine the ambient noise environment and to assess potential noise impacts, measurements of the Corona Affect were taken along an existing SDGE 69 kV transmission line located in the Borrego Springs area. This was done to determine the local conditions and to establish a baseline for the Corona Affect from a transmission line. The noise measurements were recorded on December 4, 2009 by Ldn Consulting, Inc. between approximately 9:30 a.m. and 10:00 a.m. in dry, calm and clear conditions. The sound levels for the proposed on-site equipment were taken from the manufacture's specifications.

Noise measurements were taken using a Larson-Davis Model LxT Type 1 precision sound level meter, programmed, in "slow" mode, to record noise levels in "A" weighted form. The LxT was set to record in the low range of -10 to 110 dBA. The sound level meter and microphone were mounted on a tripod, five feet above the ground and equipped with a windscreen during all measurements. The sound level meter was calibrated before and after the monitoring using a Larson-Davis calibrator, Model CAL 200.

The noise measurement location was determined based on site access and low ambient conditions to capture only the potential transmission line noise levels. The 69 kV transmission line measurements were taken mid-span between two power poles along an existing San Diego Gas & Electric (SDGE) easement. The noise measurement location and relationship to the proposed

Project location is provided graphically in Figure 1-C, denoted by the SDGE Easement marker.

**Figure 1-C: Corona Affect Noise Measurement Location**



#### b) Noise Calculations and Factors

Noise is defined as unwanted or annoying sound which interferes with or disrupts normal activities. Exposure to high noise levels has been demonstrated to cause hearing loss. The individual human response to environmental noise is based on the sensitivity of that individual, the type of noise that occurs and when the noise occurs.

Sound is measured on a logarithmic scale consisting of sound pressure levels known as a decibel (dB). The sounds heard by humans typically do not consist of a single frequency but of a broadband of frequencies having different sound pressure levels. The method for evaluating

all the frequencies of the sound is to apply an A-weighting to reflect how the human ear responds to the different sound levels at different frequencies. The A-weighted sound level adequately describes the instantaneous noise whereas the equivalent sound level depicted as  $L_{eq}$  represents a steady sound level containing the same total acoustical energy as the actual fluctuating sound level over a given time interval.

The Community Noise Equivalent Level (CNEL) is the 24 hour A-weighted average for sound, with corrections for evening and nighttime hours. The corrections require an addition of 5 decibels to sound levels in the evening hours between 7 p.m. and 10 p.m. and an addition of 10 decibels to sound levels at nighttime hours between 10 p.m. and 7 a.m. These additions are made to account for the increased sensitivity during the evening and nighttime hours when sound appears louder.

Because mobile/traffic noise levels are calculated on a logarithmic scale, a doubling of the traffic noise or acoustical energy results in a noise level increase of 3 dBA. Therefore the doubling of the traffic volume, without changing the vehicle speeds or mix ratio, results in a noise increase of 3 dBA. Mobile noise levels radiate in an almost oblique fashion from the source and drop off at a rate of 3 dBA for each doubling of distance under hard site conditions and at a rate of 4.5 dBA for soft site conditions. Hard site conditions consist of concrete, asphalt and hard pack dirt while soft site conditions exist in areas having slight grade changes, landscaped areas and vegetation. On the other hand, fixed/point sources radiate outward uniformly as it travels away from the source. Their sound levels attenuate or drop off at a rate of 6 dBA for each doubling of distance.

The most effective noise reduction methods consist of controlling the noise at the source, blocking the noise transmission with barriers or relocating the receiver. Any or all of these methods could be required to reduce noise levels to an acceptable level.

## 2.0 OPERATIONAL ACTIVITIES

### 2.1 Guidelines for the Determination of Significance

Section 36.404 of the County of San Diego noise ordinance provides performance standards and noise control guidelines for determining and mitigating non-transportation, or stationary, noise source impacts to adjacent properties. The purpose of the noise ordinance is to protect, create and maintain an environment free from noise that may jeopardize the health or welfare, or degrade the quality of life.

The County Noise Ordinance states that it shall be unlawful for any person to cause or allow the creation of any noise to the extent that the one-hour average sound level, at any point on or beyond the boundaries of the property exceeds the applicable limits provided in Table 2-1.

**Table 2-1: Sound Level Limits in Decibels (dBA)**

ZONE		APPLICABLE LIMIT ONE-HOUR AVERAGE SOUND LEVEL (DECIBELS)
R-S, R-D, R-R, R-MH, A-70, A-72, S-80, S-81, S-87, S-88, S-90, S-92, R-V, and R-U Use Regulations with a density of less than 11 dwelling units per acre.	7 a.m. to 10 p.m.	50
	10 p.m. to 7 a.m.	45
R-RO, R-C, R-M, C-30, S-86, R-V, R-U and V5. Use Regulations with a density of 11 or more dwelling units per acre.	7 a.m. to 10 p.m.	55
	10 p.m. to 7 a.m.	50
S-94, V4, and all other commercial zones.	7 a.m. to 10 p.m.	60
	10 p.m. to 7 a.m.	55
V1, V2	7 a.m. to 7 p.m.	60
V1, V2	7 p.m. to 10 p.m.	55
V1	10 p.m. to 7 a.m.	55
V2	10 p.m. to 7 a.m.	50
V3	7 a.m. to 10 p.m.	70
	10 p.m. to 7 a.m.	65
M-50, M-52, M-54	Anytime	70
S-82, M-58, and all other industrial zones.	Anytime	75

Source: County of San Diego Noise Ordinance Section 36.404

As stated above in Section 1, the Project and surrounding properties are zoned rural residential/agriculture (A-70). Section 36.404 of the Noise Ordinance sets a most restrictive



operational exterior noise limit for the A-70 and residential noise sensitive land uses of 50 dBA Leq for daytime hours of 7 a.m. to 10 p.m. and 45 dBA Leq during the noise sensitive nighttime hours of 10 p.m. to 7 a.m. as shown in Table 2-1 above. Most of the Project components will only operate during the daytime hours but a few may operate during nighttime or early morning hours and therefore the most restrictive and conservative approach is to apply the 45 dBA Leq nighttime standard at the property lines.

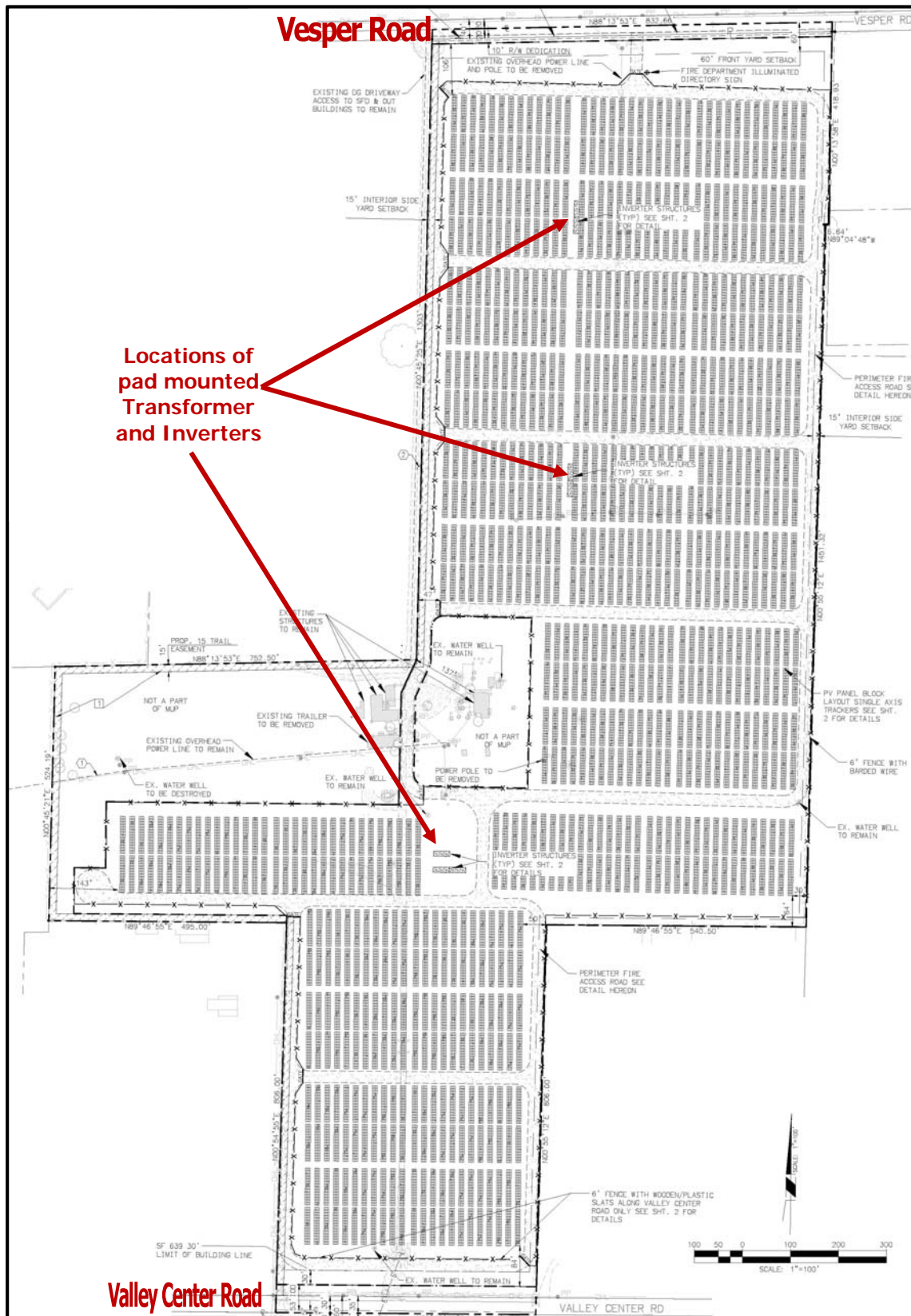
## 2.2 Potential Operational Noise Impacts

This section examines the potential stationary noise source impacts associated with the operation of the proposed Project. Specifically, noise levels from the proposed transformers, inverters and connection to existing distribution lines. Panels would be electrically connected into panel strings using wiring attached to the racking. Panel strings would be electrically connected to each other via underground wiring. Wire depths would be in accordance with local, State, and Federal codes. Gathering lines would connect individual panel strings to one or more inverters/transformers and combiner boxes distributed throughout the facility. Wiring from the panel strings are connected to combiner boxes. The electrical current is then transferred to the inverters, which convert the Direct Current (DC) produced by the PV panels into Alternating Current (AC). A pad-mounted transformer next to the inverter would increase the voltage. The AC would then travel through underground gathering lines to connect to existing distribution lines.

The Project proposes the installation of 7 small-scale, above ground structures that would be located within the solar panel fields, near the center sections of the site where needed, to shade inverter/distributor transformers and switching gear. These structures would be approximately 11 foot by 34 foot in size and 10 feet high at the roof apex. Each of these locations will house two Satcon PowerGate Plus 500 KW Commercial Solar PV Inverters, or equivalent, and one of the smaller transformers necessary to increase the voltage. The transformer and inverter locations will be spread out over the site with one transformer and one inverter grouped next to each other. The proposed inverter / transformer locations for the site can be seen in Figure 2-A.

The electric power produced by the Project will be feed into an existing transmission system across Valley Center Road. The new transfer line and increased power in the existing transmission lines, although unlikely, may increase a phenomenon referred to as the "Corona Affect" along the new transmission route. The operational noise levels from the proposed on site small-scale inverter/transformer buildings and the offsite Corona Affect are analyzed separately below.

Figure 2-A: Proposed Equipment Locations



### 2.2.1 Operational Noise Levels On-site

Energy generated by the Project would be delivered to an existing 12 kV distribution line that runs parallel to Valley Center Road. Connection would be made from the Project site either via trench under Valley Center Road or overhead connection and no substation is needed or proposed. The Project is proposing small-scaled transformers as part of the 7 proposed inverter / transformer sites. The smaller transformers consist of a 1 MVA from 200V to 12 kV. The unshielded noise levels for these small-scaled transformers are provided below (*Source: National Electric Manufacturers Association (NEMA) Publication No. TR 1-1993*):

1. 1 MVA from 200V to 12 kV - guaranteed 58 dBA @ 5 feet

As mention above, there will be up to 7 locations throughout the site with an inverter along with a small transformer. The proposed Satcon PowerGate Plus 500 KW Commercial Solar PV Inverters, or equivalent, has an unshielded noise rating of less than 65 dBA at 5 feet (*Source: Satcon PowerGate Specifications, 2008*). The NEMA test results for transformers and the proposed Satcon inverters manufacturer's specifications are provided as **Attachment A** of this report.

Based upon the Project site layout and the adjacent property zoning a potential impact may occur from the transformers and invertors located near the center of the Project site. The transformers and invertors located near the northern portion of the site are located more than 250-feet from the nearest property lines and no impacts are anticipated. The worst case scenario is analyzed below to determine if impacts would occur and if additional analysis of more pieces of equipment is warranted and if any mitigation measures will be required.

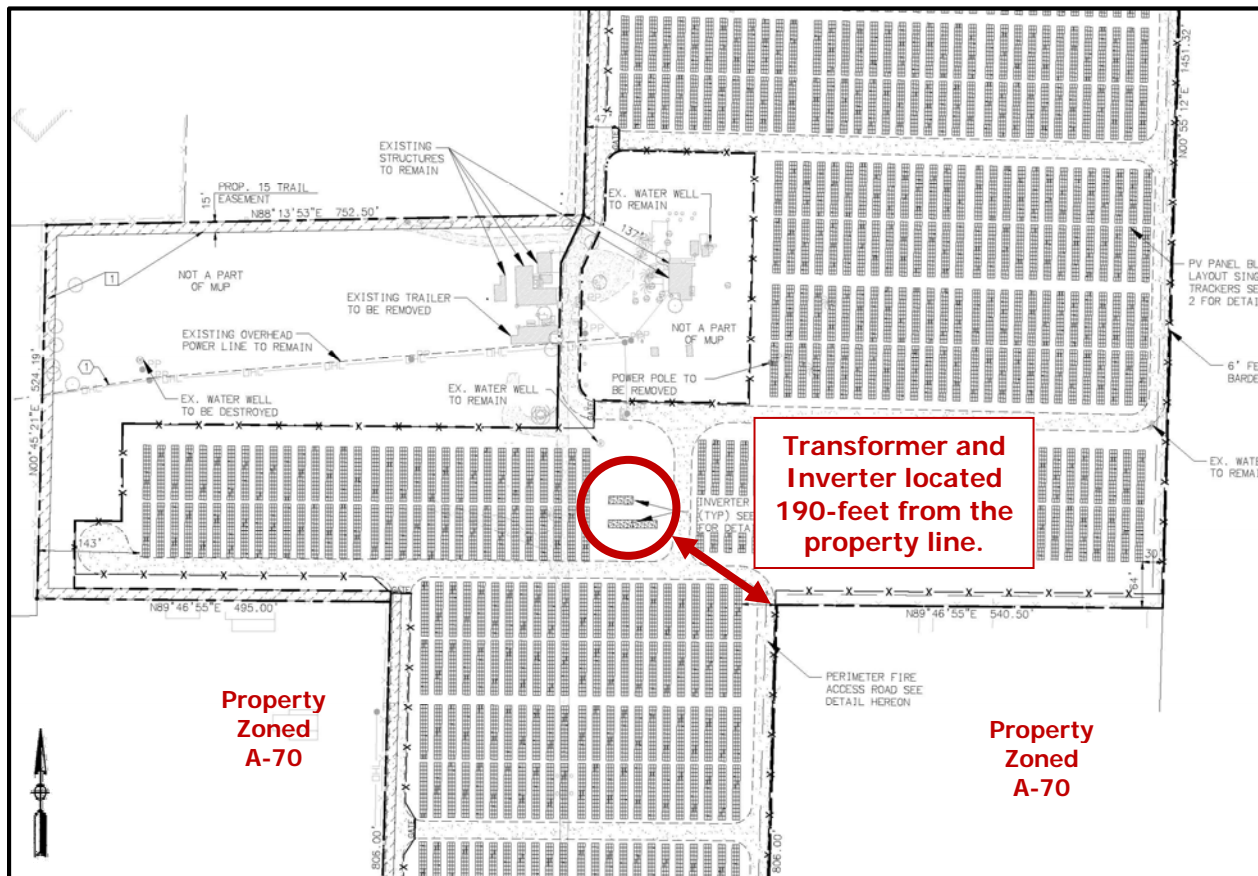
#### Transformer and Inverter Noise Levels

The worst case property line noise levels will occur where three transformers and six small inverters are located near the center of the site and are 190 feet from the nearest property in which is zoned A-70 and has a nighttime property line standard of 45 dBA. The location and relationship to the northwestern property line for this configuration is shown in Figure 2-B below. The two noise levels of 58 dBA for the transformer and 65 dBA for the inverter were combined and propagated out to the property line without any shielding. The results of the propagated noise levels are shown in Table 2-2.

The combined noise level at the nearest property line was projected to be 41.6 dBA Leq from the combination of all three transformers and six small inverters and no impacts are anticipated. In fact, at a distance of 130 feet or more the combined transformers/inverters, unshielded, will comply with the most restrictive property line standards and no future analysis is needed for the transform/inverters.



**Figure 2-B: Worst Case Property Line Orientation**



**Table 2-2: Transformer/Inverter Noise Levels – Nearest Property Line**

Source	Noise Level @ 5-Feet (dBA) <sup>1</sup>	Quantity	Cumulative Noise Level (dBA)	Distance to Nearest Property Line (Feet)	Noise Reduction due to distance (dBA)	Resultant Noise Level @ Property Line (dBA)
Transformer	58.0	3	62.8	190	-31.6	31.2
Inverter	65.0	6	72.8	190	-31.6	41.2
Cumulative Noise Level @ Property Line (dBA)						41.6
<sup>1</sup> Noise data provided as an attachment to this report						

### 2.2.2 Corona Affect Noise Levels

The Corona Affect (Corona) is a phenomenon associated with the electrical ionization of the air that occurs near the surface of the energized conductor and suspension hardware due to very high electric field strength. This is audible power line noise that is generated from electric corona discharge, which is usually experienced as a random crackling or hissing sound. The amount of corona produced by a transmission line is a function of the voltage of the line, the diameter of the conductors, the locations of the conductors in relation to each other, the elevation of the line above sea level, the condition of the conductors and hardware, and the local weather conditions.

Corona increases at higher elevations where the density of the atmosphere is less than at sea level. Audible noise will vary with elevation with the relationship of  $X/300$  where  $X$  is the elevation of the transmission line above sea level measured in meters (EPRI 2005). Audible noise at 600 meters (~2,000 feet) in elevation will be twice the audible noise at 300 meters, all other things being equal. Typically for transmission lines of 138 kV and less, the maximum corona noise during wet weather conditions is usually less than 40 dBA at the edge of the ROW (*Source: Miguel-Mission 230 kV #2 Project, Aspen Environmental Group, 2004*). Corona typically becomes a design concern for transmission lines at 345 kV and above and is less noticeable from lines like those proposed for the Project that are operated at lower voltages.

The electric field gradient is greatest at the surface of the conductor. Large-diameter conductors have lower electric field gradients at the conductor surface and, hence, lower corona than smaller conductors. Irregularities, such as nicks and scrapes on the conductor surface, concentrate the electric field at these locations and increase the electric field gradient and thus the resulting corona. Similarly, dust or insects on the conductor surface can cause irregularities and are a source for corona along with moisture from fog or raindrops. Corona noise is primarily audible during wet weather conditions such as fog and rain. Heavy rain will typically generate a noise level from the falling rain drops hitting the ground that will be greater than the noise generated by corona and thus mask the audible noise from the transmission line.

Corona produced by a transmission line can be reduced by changing the design of the transmission line and through the selection of the conductors and hardware used for the construction of the line. For instance the use of conductor hangers that have rounded rather than sharp edges and no protruding sharp edges will help reduce corona.

To determine the corona from a transmission line, noise measurements were taken along an existing 69 kV transmission lines in the Borrego Springs area. The short-term measurements were conducted by Ldn Consulting December 4, 2009. The noise measurements were conducted along an SDGE easement south of Borrego Springs as depicted previously in Figure

1-C. Due to ambient noise sources consisting of airplanes, automobiles and birds only one-minute measurements could be taken without the results being affected by factors other than the existing 69 kV transmission lines. During the noise measurements, the crackling or hissing of the transmission lines was slightly audible and the weather conditions were dry and calm. The results of those short-term measurements are provided in Table 2-3 below.

**Table 2-3: Measured Corona Noise Levels along 69 kV Lines**

Location	Time	One Hour Noise Levels (dBA)					
		Leq	Lmin	Lmax	L10	L50	L90
69 kV Transmission Lines – Borrego Springs	9:35–9:36 a.m.	17.6	16.7	22.7	18.7	17.0	16.8
69 kV Transmission Lines – Borrego Springs	9:37–9:38 a.m.	18.3	17.4	27.2	19.3	18.1	17.7
Source: Ldn Consulting, Inc. December 4, 2009							

As can be seen in Table 2-3, during the dry conditions the noise levels from the Corona were very low, below 20 dBA. Typically during moist or wet conditions the Corona noise can double. This would result in a noise level of 35-37 dBA which is consistent with previous studies and modeling efforts conducted by the Electric Power Research Institute (EPRI) and CH2M Hill for the Cross Valley Transmission Line Project conducted for Southern California Edison 2008.

## 2.3 Conclusions

Based on the empirical data, the manufactures specifications and the distances to the property lines the unshielded cumulative noise levels from the proposed transformers/inverters were found to be below the most restrictive nighttime property line standard of 45 dBA at the A-70 zoning. No impacts are anticipated and no mitigation is required.

The measured Corona Affect noise levels were found to be below the County of San Diego's most restrictive nighttime standard of 45 dBA. This was also consistent with previously measured and modeled noise levels on transmission line projects throughout California. No impacts from the Corona Affect are anticipated from the connection to existing distribution lines associated with the Project.

### **3.0 CONSTRUCTION ACTIVITIES**

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#### **3.1 Guidelines for the Determination of Significance**

Construction Noise: Noise generated by construction activities related to the project will exceed the standards listed in San Diego County Code Sections as follows.

#### **SEC. 36.408: HOURS OF OPERATION OF CONSTRUCTION EQUIPMENT**

Except for emergency work, it shall be unlawful for any person to operate or cause to be operated, construction equipment:

- a. Between 7 p.m. and 7 a.m.
- b. On a Sunday or a holiday. For purposes of this section, a holiday means January 1st, the last Monday in May, July 4th, the first Monday in September, December 25th and any day appointed by the President as a special national holiday or the Governor of the State as a special State holiday. A person may, however, operate construction equipment on a Sunday or holiday between the hours of 10 a.m. and 5 p.m. at the person's residence or for the purpose of constructing a residence for himself or herself, provided that the operation of construction equipment is not carried out for financial consideration or other consideration of any kind and does not violate the limitations in sections 36.409 and 36.410.

#### **SEC. 36.409: SOUND LEVEL LIMITATIONS ON CONSTRUCTION EQUIPMENT**

Except for emergency work, it shall be unlawful for any person to operate construction equipment or cause construction equipment to be operated, that exceeds an average sound level of 75 decibels for an eight-hour period, between 7 a.m. and 7 p.m., when measured at the boundary line of the property where the noise source is located or on any occupied property where the noise is being received.

#### **SEC. 36.410: SOUND LEVEL LIMITATIONS ON IMPULSIVE NOISE**

In addition to the general limitations on sound levels in section 36.404 and the limitations on construction equipment in section 36.409, the following additional sound level limitations shall apply:

- (a) Except for emergency work or work on a public road project, no person shall produce or cause to be produced an impulsive noise that exceeds the maximum sound level shown in Table 36.410A (provided below), when measured at the boundary line of the property where the noise source is located or on any occupied property where the noise is received, for 25 percent of the minutes in the measurement period, as described in subsection (c) below. The maximum sound level depends on the use being made of the occupied property. The uses in Table 36.410A are as described in the County Zoning Ordinance.

**TABLE 36.410A: MAXIMUM SOUND LEVEL (IMPULSIVE) MEASURED AT OCCUPIED PROPERTY IN DECIBELS (dBA)**

OCCUPIED PROPERTY USE	DECIBELS (dBA)
Residential, village zoning or civic use	82
Agricultural, commercial or industrial use	85

- (b) Except for emergency work, no person working on a public road project shall produce or cause to be produced an impulsive noise that exceeds the maximum sound level shown in Table 36.410B, when measured at the boundary line of the property where the noise source is located or on any occupied property where the noise is received, for 25 percent of the minutes in the measurement period, as described in subsection (c) below. The maximum sound level depends on the use being made of the occupied property. The uses in Table 36.410B are as described in the County Zoning Ordinance.

**TABLE 36.410B: MAXIMUM SOUND LEVEL (IMPULSIVE) MEASURED AT OCCUPIED PROPERTY IN DECIBELS (dBA) FOR PUBLIC ROAD PROJECTS**

OCCUPIED PROPERTY USE	dB(A)
Residential, village zoning or civic use	85
Agricultural, commercial or industrial use	90

- (c) The minimum measurement period for any measurements conducted under this section shall be one hour. During the measurement period a measurement shall be conducted every minute from a fixed location on an occupied property. The measurements shall measure the maximum sound level during each minute of the measurement period. If the sound level caused by construction equipment or the producer of the impulsive noise exceeds the maximum sound level for any portion of any minute, it will be deemed that the maximum sound level was exceeded during that minute.

### 3.2 Potential Construction Noise Impacts

Construction noise represents a short-term impact on the ambient noise levels. Noise generated by construction equipment includes haul trucks, water trucks, graders, dozers, loaders and scrapers can reach relatively high levels. Grading activities typically represent one of the highest potential sources for noise impacts and little or no grading will be necessary for this project. The most effective method of controlling construction noise is through local control of construction hours and by limiting the hours of construction to normal weekday working hours.

The U.S. Environmental Protection Agency (U.S. EPA) has compiled data regarding the noise generating characteristics of specific types of construction equipment. Noise levels generated by heavy construction equipment at a distance of 50 feet can range from 60 dBA for a small tractor up to 100 dBA for rock breakers. However, these noise levels diminish rapidly with distance from the construction site at a rate of approximately 6 dBA per doubling of distance. For example, a noise level of 87 dBA measured at 50 feet from the noise source would be reduced to 81 dBA at 100 feet from the source and be further reduced to 75 dBA at 200 feet from the source.

Using a point-source noise prediction model, calculations of the expected construction noise impacts were completed. The essential model input data for these performance equations include the source levels of each type of equipment, relative source to receiver horizontal and vertical separations, the amount of time the equipment is operating in a given day, also referred to as the duty-cycle and any transmission loss from topography or barriers. To determine the worst-case noise levels for the grading operations no topographic attenuation, duty-cycle reductions or barrier reductions were utilized. According to the project applicant, the project site will be grubbed to remove vegetation and compacted in one phase followed by the installation of the PV panels in one phase. The grading and subsequent installation of the PV panels is discussed separately below.

The clearing operation may utilize a total of up to three dozers, five graders, four loaders/backhoes and four water trucks. This is more construction equipment than is anticipated to be needed during site preparation and installation. This list was analyzed to be overly conservative and provide a worse case assessment. The noise levels utilized in this analysis based upon the conservative list of equipment as shown in Table 3-1 below. Most of the construction activities will consist of clearing and grubbing the site for the preparation of the PV panels. The equipment is anticipated to be spread out over the entire site with some equipment potentially operating at or near the property line while the rest of the equipment may be located over 1,000 feet from the same property line. This would result in an acoustical center for the grading operation at approximately 500 feet from the nearest property line.

As can be seen in Table 3-1, if all the equipment was operating in the same location, which is not physically possible, at a distance as close as 165 feet from the nearest property line the point source noise attenuation from construction activities is -10.4 dBA. This would result in an anticipated worst case eight-hour average combined noise level of 74.9 dBA at the property line. Given this and the spatial separation of the equipment, the noise levels will comply with the County of San Diego's 75 dBA standard at all Project property lines.

**Table 3-1: Site Preparation Noise Levels**

Construction Equipment	Quantity	Duty Cycle (Hours/Day)	Source Level @ 50-Feet (dBA)	Cumulative Noise Level @ 50-Feet (dBA Leq-8h)
Grader	5	8	74	81.0
Water Truck	4	8	70	76.0
Dozer	3	8	75	79.8
Loader	4	8	73	79.0
Cumulative Levels @ 50 Feet (dBA)				85.3
Distance To Property Line				165
Noise Reduction Due To Distance				-10.4
NEAREST PROPERTY LINE NOISE LEVEL				74.9

The installation of the PV panels will utilize a total of two small pile drivers to install the panel stands, two mobile cranes to move the PV panel in position and two pneumatic tools to secure the panels to the stands. The noise levels utilized in this analysis based upon the anticipated list of equipment are shown in Table 3-2. Based upon normal installation procedures the equipment is anticipated to be spread out over the entire site with pile driving occurring first and then the installation of the PV panels with a crane and pneumatic tool. Some equipment may be operating at a distance of 70-120 feet from the property line while the rest of the equipment may be located over 500 feet from the other equipment and same property line. This would result in an acoustical center from the installation operations of at least 300 feet to the nearest property line around the perimeter of the site. The distance to the property lines would increase as the interior panels are installed and the noise levels would decrease due to distance.

**Table 3-2: PV Panel Installation Noise Levels**

Construction Equipment	Quantity	Duty Cycle (Hours/Day)	Source Level @ 50-Feet (dBA)	Cumulative Noise Level @ 50-Feet (dBA Leq-8h)
Pneumatic Tool	2	8	82	85.0
Mobile Crane	2	8	78	81.0
Pile Driver	2	8	84	87.0
Cumulative Levels @ 50 Feet (dBA)				89.8
Distance To Property Line				275
Noise Reduction Due To Distance				-14.8
NEAREST PROPERTY LINE NOISE LEVEL				74.9



As can be seen in Table 3-2, if all the equipment was operating in the same location, which is not physically possible, at a distance as close as 275 feet from the nearest property line the point source noise attenuation from construction activities is -14.8 dBA. This would result in an anticipated worst case eight-hour average combined noise level of 74.9 dBA at the property line. Given this and the spatial separation of the equipment, the noise levels will comply with the County of San Diego's 75 dBA standard at all Project property lines.

Additionally, the County Noise Ordinance Section 36.410, states that except for emergency work or work on a public road project, no person shall produce or cause to be produced an impulsive noise that exceeds the maximum sound level shown of 82 dBA (at residential uses), when measured at the boundary line of the property where the noise source is located or on any occupied property where the noise is received, for 25 percent of the minutes in the measurement period. The maximum sound level and uses are shown above in Table 36.410A as described in the County Zoning Ordinance.

The installation of the PV panels will utilize a total of two small pile drivers to install the panel stands that could produce impulsive noise. Based upon normal installation procedures the two pile drivers are anticipated to be separated on the site. A single pile driver would be operating at a distance of 50 feet from the property line for a short time to install a single panel stand. The pile driver would then move further from the property line to set another panel stand and continue in this fashion. Each panel stand installation process is only anticipated to last 5 minutes or less.

Pile drivers can produce maximum noise levels ( $L_{max}$ ) of 95 dBA at a distance of 50 feet when the drive head is operating (Source: Central Artery/Tunnel (CA/T) project in Boston, Massachusetts). Typically, a pile drive is not continuously operating at full power; this is referred to as the usage factor. The usage factor is the percentage of time during a construction noise operation that a piece of construction equipment is operating at full power. Based on empirical data collected CA/T project which was used to develop the Road Construction Noise Model (RCNM), a pile driver has a usage factor of 20%. Since the maximum noise level from a pile driver exceeds the County's maximum noise level threshold of 82 dBA the following recommendations are presented. To reduce the maximum noise level of 95 dBA to 82 dBA the pile driver would need to be located 215 feet from the nearest occupied residential property line or only operate 25% of the hourly or daily duration (15 minutes of any hour and 2 hours of a 8 hour work day) when located within that distance. Based on these duration and distance parameters the impulsive noise levels are anticipated to be below the County's most restrictive 82 dBA threshold and no impacts are anticipated and no mitigation measures are required.

### 3.2 Construction Conclusions

At a distance as close as 165 feet the point source noise attenuation from the grading activities and the nearest property line is -10.4 dBA. This would result in an anticipated worst case eight-hour average combined noise level of 74.9 dBA at the property line. During the installation of the PV panels at a distance of 275 feet would result in a noise level of 74.9 dBA. The installation equipment is anticipated to average more than 300 feet from the nearest property line. Given this and the spatial separation of the equipment over the large site area, the noise levels of the grading and PV panel installation are anticipated to comply with the County of San Diego's 75 dBA standard at all Project property lines.

Additionally, the County Noise Ordinance Section 36.410, states that no person shall produce or cause to be produced an impulsive noise that exceeds the maximum sound level shown of 82 dBA (at residential uses), when measured at the boundary line of the property where the noise source is located or on any occupied property where the noise is received, for 25 percent of the minutes in the measurement period. To reduce the maximum noise level of 95 dBA to 82 dBA the pile driver would need to be located 215 feet from the nearest occupied residential property line or only operate 25% of the hourly or daily duration (15 minutes of any hour and 2 hours of a 8 hour work day) when located within that distance. Based on these duration and distance parameters the impulsive noise levels are anticipated to be below the County's most restrictive 82 dBA threshold and no impacts are anticipated and no mitigation measures are required.

## **4.0 SUMMARY OF PROJECT IMPACTS, MITIGATION & CONCLUSIONS**

- Operational Noise Analysis

Based on the empirical data, the manufactures specifications and the distances of more than 95-feet to the property lines the unshielded cumulative noise levels from the proposed transformers/inverters were found to be below the most restrictive nighttime property line standard of 45 dBA at the A-70 zoning. No impacts are anticipated and no mitigation is required.

The measured Corona Affect noise levels were found to be below the County of San Diego's most restrictive nighttime standard of 45 dBA. This was also consistent with previously measured and modeled noise levels on transmission line projects throughout California. No impacts from the Corona Affect are anticipated from the connection to existing distribution lines associated with the Project.

- Construction Noise Analysis

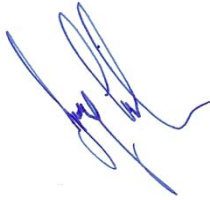
At a distance as close as 165 feet the point source noise attenuation from the grading activities and the nearest property line is -10.4 dBA. This would result in an anticipated worst case eight-hour average combined noise level of 74.9 dBA at the property line. During the installation of the PV panels at a distance of 275 feet would result in a noise level of 74.9 dBA. The installation equipment is anticipated to average more than 300 feet from the nearest property line. Given this and the spatial separation of the equipment over the large site area, the noise levels of the grading and PV panel installation are anticipated to comply with the County of San Diego's 75 dBA standard at all Project property lines.

Additionally, the County Noise Ordinance Section 36.410, states that no person shall produce or cause to be produced an impulsive noise that exceeds the maximum sound level shown of 82 dBA (at residential uses), when measured at the boundary line of the property where the noise source is located or on any occupied property where the noise is received, for 25 percent of the minutes in the measurement period. To reduce the maximum noise level of 95 dBA to 82 dBA the pile driver would need to be located 215 feet from the nearest occupied residential property line or only operate 25% of the hourly or daily duration (15 minutes of any hour and 2 hours of a 8 hour work day) when located within that distance. Based on these duration and distance parameters the impulsive noise levels are anticipated to be below the County's most restrictive 82 dBA threshold and no impacts are anticipated and no mitigation measures are required.

## 5.0 CERTIFICATIONS

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The contents of this report represent an accurate depiction of the existing and future acoustical environment and impacts within the proposed Sol Orchard - Valley Center Solar Project. The report was prepared by Jeremy Loudon; a County approved CEQA Consultant for Acoustics.



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Date November 11, 2011

**ATTACHMENT A**

MANUFACTURES SPECIFICATIONS AND NOISE DATA  
(Transformers and Inverters)

**NEMA Standards Publication No. TR 1-1993 (R2000)**

*Transformers, Regulators and Reactors*

*Published by:*

**National Electrical Manufacturers Association**  
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Rosslyn, VA 22209

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## FOREWORD

The standards appearing in this publication have been developed by the Transformer Section and have been approved for publication by the National Electrical Manufacturers Association. They are used by the electrical industry to promote production economies and to assist users in the proper selection of transformers.

The Transformer Section is working actively with the American National Standards Committee, C57, on Transformers, Regulators and Reactors, in the development, correlation and maintenance of national standards for transformers. This Committee operates under the procedures of the American National Standards Institute (ANSI).

It is the policy of the NEMA Transformer Section to remove material from the NEMA Standards Publication as it is adopted and published in the American National Standard C57 series. The NEMA Standards Publication for Transformers, Regulators and Reactors references these and other American National Standards applying to transformers, and is intended to supplement, without duplication, the American National Standards.

The NEMA Standards Publication for Transformers, Regulators and Reactors contains provision for the following:

- a. American National Standards adopted by reference and applicable exceptions approved by NEMA, if any.
- b. NEMA Official Standards Proposals. These are official drafts of proposed standards developed within NEMA or in cooperation with other interested organizations, for consideration by ANSI. They have a maximum life of five years, during which time they may be approved as American National Standards or adopted as NEMA Standards, or rescinded.
- c. Manufacturing Standards. These are NEMA Standards which are primarily of interest to the manufacturers of transformers and which are not yet included in an American National Standard.
- d. Standards Which Are Controversial. These are NEMA Standards, on which there is a difference of opinion within Committee C57. The NEMA version will be included in the NEMA Standards Publication until such time as the differences between ANSI and NEMA are resolved.

NEMA Standards Publications are subject to periodic review and take into consideration user input. They are being revised constantly to meet changing economic conditions and technical progress. Users should secure latest editions. Proposed or recommended revisions should be submitted to:

Vice President, Engineering Department  
National Electrical Manufacturers Association  
2101 L Street, N.W.  
Washington, D.C. 20037-1526

## SCOPE

This publication provides a list of all ANSI C57 Standards that have been approved by NEMA. In addition it includes certain NEMA Standard test methods, test codes, properties, etc., of liquid-immersed transformers, regulators, and reactors that are not American National Standards.

## PART 0 GENERAL

The following American National Standards have been approved as NEMA Standards and should be inserted in this Part 0:

ANSI/IEEE C57.12.00-1988	<i>General Requirements for Liquid-Immersed Distribution, Power and Regulating Transformers</i>
ANSI/IEEE C57.12.01-1989	<i>General Requirements for Dry Type Power and Distribution Transformers</i>
ANSI C57.12.10-1988	<i>Requirements for Transformers 230,000 volts and below, 833/958-8333/10,417 kVA single-phase 750/862-60,000/80,000/100,000 kVA three phase, including supplements</i>
ANSI C57.12.70-1993	<i>Terminal Markings and Connections for Distribution and Power Transformers</i>
ANSI/IEEE C57.12.90-1993	<i>Test Code for Liquid-immersed Distribution, Power &amp; Regulating Transformers and Guide for Short-Circuit Testing of Distribution &amp; Power Transformers</i>
ANSI/IEEE C57.19.00-1992	<i>General Requirements and Test Procedure for Outdoor Apparatus Bushings</i>
ANSI/IEEE C57.19.01-1992	<i>Standard Performance Characteristics &amp; Dimensions for Outdoor Apparatus Bushings</i>
ANSI/IEEE C57.92-1992	<i>Guide for Loading Mineral-oil-immersed Power Transformers up to and including 100 MVA with 55C or 65C Average Winding Rise</i>

The NEMA Standards TR 1-0.01 through TR 1-0.09 on the following pages (see Part 0 Pages 1-9) also apply generally to transformers.

### 0.01 PREFERRED VOLTAGE RATINGS

Preferred system voltages and corresponding transformer voltage ratings are given in the American National Standard for Electric Power Systems and Equipment--Voltage Ratings (60 Hz), C84.1-1989. It is recommended that these ratings be used as a guide in the purchase and operation of transformers.

### 0.02 FORCED-AIR (FA) AND FORCED-OIL (FOA) RATINGS

Under the conditions of par. 5.11 of American National Standard ANSI/IEEE C57.12.00-1988, the relationship between self-cooled ratings and forced-air-cooled or forced-oil-cooled ratings shall be in accordance with Table 0-1.

**Table 0-1  
FORCED-AIR AND FORCED-OIL RATINGS RELATIONSHIPS**

Class	Self-cooled Ratings* (kVA)		Percent of Self-Cooled Ratings With Auxiliary Cooling	
	Single Phase	Three Phase	First Stage	Second Stage
OA/FA	501-2499	501-2499	115	--
OA/FA	2500-9999	2500-11999	125	--
OA/FA	10000 and above	12000 and above	133-1/3	--
OA/FA/FA	10000 and above	12000 and above	133-1/3	166-2/3
OA/FA/FOA	10000 and above	12000 and above	133-1/3	166-2/3
OA/FOA/FOA	10000 and above	12000 and above	133-1/3	166-2/3

\*In the case of multi-winding transformers or autotransformers, the ratings given are the equivalent two-winding ratings.



## PERFORMANCE

### 0.03 RADIO INFLUENCE VOLTAGE LEVELS

The following values apply to liquid-filled transformers. They do not apply to load tap changing during switching or to operation of auxiliary relays and control switches.

#### 0.03.1 Distribution Transformers

Radio influence voltage levels for distribution transformers, for systems rated 69 kV and less, shall not exceed 100 microvolts when measured in accordance with Section 7.01. The test voltage shall be the line-to-neutral voltage corresponding to 110 percent excitation of the transformer. This will be the coil voltage for wye connections and 1/3 times the coil voltage for delta connections.

### 0.04 POWER FACTOR OF INSULATION OF OIL-IMMERSED TRANSFORMERS

While the real significance which can be attached to the power factor of oil-immersed transformers is still a matter of opinion, experience has shown that power factor is helpful in assessing the probable conditions of the insulation when good judgement is used.

The proper interpretation of power factor of oil-immersed transformers is being given careful attention by manufacturers in connection with the problems of (1) selecting insulating materials, (2) sealing, and (3) processing the transformers. However, it is the comparative values which are guides for the successful solution for these problems rather than an absolute value of power factor.

The generally accepted factory tests for proving the insulation level are the prescribed low-frequency tests and impulse tests given in the American National Standard C57.12.90-1993.

When required, a factory power-factor test can be made, and this measurement will be of value for comparison with field power-factor measurements to assess the

probable condition of the insulation. It is not feasible to establish standard power-factor values for oil-immersed transformers because:

- a. Experience has definitely proved that little or no relation exists between power factor and the ability of the transformer to withstand the prescribed dielectric tests.
- b. Experience has definitely proved that the variation in power factor with temperature is substantial and erratic so that no single correction curve will fit all cases.

When a factory power-factor measurement of a transformer is required, the measurement should be made with the insulation at room temperature, preferably at or close to 20°C.

### 0.05 AUDIBLE SOUND LEVELS

Transformers shall be so designed that the average sound level will not exceed the values given in Tables 0-2 through 0-4 when measured at the factory in accordance with the conditions outlined in ANSI/IEEE C57.12.90-1993.

The guaranteed sound levels should continue to be per Tables 0-2 through 0-4 until such time as enough data on measured noise power levels becomes available.

Sound pressure levels are established and published in this document. Sound power may be calculated from sound pressure, using the method described in C57.12.90-1993.

Rectifier, railway, furnace, grounding, mobile and mobile unit substation transformers are not covered by the tables. The tables do not apply during the time that power switches are operating in load-tap-changing transformers and in transformers with integral power switches.





**Table 0-3**  
**AUDIBLE SOUND LEVELS FOR LIQUID-IMMERSED**  
**DISTRIBUTION TRANSFORMERS AND NETWORK TRANSFORMERS**

Equivalent Two-winding kVA	Average Sound Level, Decibels
0-50	48
51-100	51
101-300	55
301-500	56
750	57
<b>Small Transformer</b> 1000	58
1500	60
2000	61
2500	62

**Table 0-4**  
**AUDIBLE SOUND LEVELS FOR DRY-TYPE TRANSFORMERS 15000-VOLT**  
**NOMINAL SYSTEM VOLTAGE AND BELOW**

Equivalent Two-Winding kVA	Average Sound Level, Decibels		Equivalent Two-winding kVA	Average Sound Level, Decibels
	Self-cooled Ventilated*	Self-cooled Sealed*		Ventilated Forced Air Cooled **,†
0-50	50	50	...	...
51-150	55	55	...	...
151-300	58	57	3-300	67
301-500	60	59	301-500	67
501-700	62	61	501-833	67
701-1000	64	63	834-1167	67
1001-1500	65	64	1168-1667	68
1501-2000	66	65	1668-2000	69
2001-3000	68	66	2001-3333	71
3001-4000	70	68	3334-5000	73
4001-5000	71	69	5001-6667	74
5001-6000	72	70	6668-8333	75
6001-7500	73	71	8334-10000	76

\* Class AA rating

\*\*Does not apply to sealed-type transformers

†Class FA and AFA ratings

## **Part 1**

### **POWER TRANSFORMERS**

The American National Standard C57.12.10-1988 has been approved as a NEMA Standard for power transformers and should be inserted in this Part 1.

The ANSI/IEEE Standard C57.92-1992, has been approved by NEMA and should be inserted in this Part 1.

The following other parts of this NEMA Publication No. TR 1 shall also apply:

- a. Part 1 General
- b. Part 6 Terminology
- c. Part 7 Test Code
- d. Part 12 Underground-Type Three-Phase Distribution Transformer



## Unparalleled Performance

Satcon enables you to closely match array capacities to achieve maximum energy throughput.



### Edge™ MPPT

Features a proprietary maximum power point tracking (MPPT) system

Provides rapid and accurate control

Improves performance by up to 20%, even in challenging climate conditions

Boosts overall PV plant kilowatt yield

Provides a wide range of operation across all photovoltaic cell technologies, including thin film, monocrystalline, and polycrystalline PV panels

### Power Efficiency

Full array nameplate power rating maintained throughout the entire MPPT DC voltage range

Superior dynamic performance in cloudy conditions

### Printed Circuit Board Durability

Wide thermal operating range: -40° C (-40° F) to 85° C (185° F)

Conformal coated to withstand extreme humidity and air-pollution levels

## Proven Reliability

Rugged and reliable, PowerGate Plus PV inverters are engineered from the ground up to meet the demands of large-scale installations.

### Low Maintenance

Modular components make service efficient

Dual cooling fans

### Safety

Seismic Zone 4 compliant

Built-in DC and AC disconnect switches

Integrated DC two-pole disconnect switch isolates the inverter (with the exception of the GFDI circuit) from the photovoltaic power system to allow inspection and maintenance

Protective cover over exposed power connections

## PowerGate® Plus 1 MW Commercial Solar PV Inverter



### PowerGate Plus 1 MW Specifications

#### UL/CSA

#### CE

#### Input Parameters

Maximum Array Input Voltage	900V DC (CE)	•	•
Input Voltage Range (MPPT; Full Power)	420–850V DC	•	•
Maximum Input Current	2,397A DC	•	•

#### Output Parameters

Nominal Output Voltage to Transformer	265V AC	•	•
Output Frequency Range	59.5–60.5 Hz	•	
	49.5–50.5 Hz		•
AC Voltage Range Set Points	-12%/+10%	•	•
Nominal Output Frequency	60 Hz	•	
	50 Hz		•
Number of Phases	3	•	•
Maximum Output Current per Phase	2,178A	•	•
Maximum Overcurrent Protection per Phase	2,614A	•	•
CEC-Weighted Efficiency	97%	•	•
Maximum Continuous Output Power	1000 kW (1000 kVA)	•	•
Power Factor at Full Load	>0.99	•	•
Harmonic Distortion	<3% THD	•	•

#### Temperature

Operating Ambient Temperature Range (Full Power)	-20° C to +50° C	•	•
Storage Temperature Range	-30° C to +70° C	•	•
Cooling	Forced Air	•	•

#### Noise

Noise Level	<65 dB(A)	•	•
-------------	-----------	---	---

• Standard • Optional



### PowerGate Plus 1 MW

UL/CSA 265V AC Output

CE 265V AC Output

External transformer required.

### Streamlined Design

With all components encased in a single, space-saving enclosure, PowerGate Plus PV inverters are easy to install, operate, and maintain.

### Single Cabinet with Small Footprint

Convenient access to all components

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### Rugged Construction

Engineered for outdoor environments

### Output Transformer (Optional)

Provides galvanic isolation

Uses medium voltage output to accommodate long-distance power feeds to designated loads or substations

PowerGate Plus 1 MW Specifications		UL/CSA	CE
<b>Combiner</b>			
Number of Inputs and Fuse Rating	40 (160A DC) (Opt.)	○	○
	60 (100A DC) (Opt.)	○	○
<b>Transformer</b>			
External Transformer		○	○
<b>Inverter and Integrated External Transformer Cabinets</b>			
Enclosure Rating (Outdoor)	NEMA 3R, IP44	●	●
Enclosure Finish (16-Gauge, Powder-Coated Steel)	RAL-7032	●	●
Base and Door Finish (14-Gauge, Powder-Coated Steel)	RAL-7032	●	●
Cabinet Dimensions (Height x Width x Depth)	Inverter	107" x 148" x 84" (272 cm x 376 cm x 213 cm)	
Cabinet Weight	Inverter	12,000 lbs.	5,443 kg
<b>Testing and Certification</b>			
UL1741, CSA 107.1-01, IEEE 1547, IEEE C62.41.2		●	
CE Certification			●
Zone 4 Seismic Rating		●	●
<b>Warranty</b>			
Five Years		●	●
Extended Warranty (10, 15, or 20 years) (Optional)		○	○
Extended Service Agreement (Optional)		○	○
<b>Intelligent Monitoring</b>			
Satcon PV View® Plus (Optional)		○	○
Satcon PV Zone (Optional)		○	○
Third-Party Compatibility		○	○

- Standard
- Optional

Note: Specifications are subject to change.

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